

DOCUMENT MICROFILMING IDENTIFICATION

GEOCREŠ No. 31E-103

DIST. 11 REGION

W.P. No. 148-86-02

CONT. No. 89-17

W. O. No.

STR. SITE No. 42-190

HWY. No. 11/60

LOCATION Junction Hwy 11/60

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Ministry of
Transportation and
Communications

P. Payer.

FOUNDATION DESIGN SECTION

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 148-86-00⁰² DIST 11
HWY 11 STR SITE 42-190

Highway 60 Underpass

DISTRIBUTION

P. Stuart (2)
J. McDougall
K. Williams
D. Barnes (2)
K. Bassi
J.H. Peer
T. Yakutchuk
A. Szekreny
L. Argo (Cover Only)
M. Maclean (Cover Only)
File

FOUNDATION INVESTIGATION REPORT
For
Highway 11/60 - Interchange, Underpass
W.P. 148-86-00, Site: 42-190
Highway 11,
District #11, Huntsville

INTRODUCTION

This report contains the results of the Foundation Investigation carried out at the above-mentioned site from 87 08 17 to 87 08 19. The field work consisted of ten sampled boreholes and two dynamic cone penetration tests. The borings were advanced by hollow (8.3 cm I.D.) and solid stem augers, using a muskeg vehicle mounted auger machine.

Sampling was performed to a maximum depth of 7.3 m to an approximate elevation of 296.3 m and the cone tests to a maximum depth of 1.1 m to Elevation 302.4 m.

SITE DESCRIPTION

The site is located just northwest of the Town of Huntsville, in the northern Muskoka tourist region, at the junctions of Highways #11 and #60. The surrounding terrain is generally hilly with rock outcropping on the west and northeast sides in the vicinity of the site. The vegetation at the site is largely that of coniferous trees.

SUBSURFACE CONDITIONS

General

The overburden material encountered was found to consist mainly of sand, some gravel, some fines and in one borehole of silty clay, trace of sand. The bedrock encountered is classified as gneiss. The plan and location of boring and the stratigraphical profile are shown on Drawing Number 1488600-A in the attached Appendix. The obtained field and laboratory test results are plotted on the Record of Borehole Sheets also in the Appendix of this report. A brief description of the different soil types follows.

Silty clay, trace of sand

Below the ground surface at BH #1 to bedrock a metre thick deposit of silty clay of low plasticity, trace of sand was encountered. The physical properties of the material as determined by laboratory tests are:

Natural moisture content (w) was approximately 25%

Liquid limit (wL) 31%

Plastic Limit (wp) 9%

Grain-size distribution consisted of 7% sand and 93% fines (silt and clay).

The consistency of the deposit ranged from firm to stiff.

Sand, some gravel, some silt

The material was found below the ground surface at all boreholes with the exception of BH #1 and BH #3 (Borehole #3 contained boulders which made proper sampling impossible). The material extended to bedrock therefore the deposit varied in depth from 0.5 to 4 m.

The average natural moisture content of the material was approximately 6.5%. The denseness of the overall material ranges from dense to very dense. Figure 1, shows the results of the grain-size distribution for this material in envelope form.

Bedrock

Bedrock was encountered below the overburden material at the following elevations:

<u>Borehole</u>	<u>Bedrock (m)</u>	<u>Unweathered Bedrock (m)</u>
1	302.5	302.5
2	302.0	302.0
3	301.9	301.9
4	299.5	299.3

(The following elevations are presumed)

5	308.1
6	309.3
7	308.7
8	307.9
9	307.5
10	307.5

Bedrock is Gneiss of Precambrian age. The rock core samples were examined by Mr. S. A. Senior, Geological Engineer, and his description is included in Figure 2 of the Appendix of this report.

Groundwater Conditions

All boreholes were found to be dry during the field investigation, therefore, no groundwater levels were recorded. However, it should be noted that this may vary seasonally.

Discussion and Recommendations

General

It is presently proposed to build a structure over Highway #11 to carry the Highway #60 traffic which is presently a level interchange.

The proposals made are a two-span structure with the following alternatives.

1. West Abutment at Station 9 + 959.6 ± or alternatively 3 m or 6 m further from C of Highway #11.
2. East Abutment at Station 10 + 034 ± or alternatively 3 m or 6 m further from C of Highway #11.
3. Centre Pier at Station 10 + 000.0 ± or alternatively at Station 9 + 996.8 ±.

Structure Foundations

In view of the encountered subsurface conditions the following foundation recommendations are being made:

1. The abutments and piers may be founded within the sound bedrock at a convenient level. The footings should be keyed into the bedrock 0.5 m. Steps may be constructed if necessary. The elevations of the bedrock surface are all shown in the appendix and may be interpolated from the profile.

Factored Bearing Capacity at U.L.S. 10,000 kPa

2. The east abutment may also be founded on HP 310 x 110 steel 'H' piles. A design load of 1150 kN is recommended. For the purpose of the O.H.B.D.C., the following values are recommended:

Factored bearing Capacity at U.L.S. 1600 kN

Capacity at S.L.S. Type II 1150 kN

All piles should be reinforced with pile tips.

The abutments should be backfilled with a free draining granular material and earth pressures against the abutment walls should be computed as per Sub-section 6.6.1.2 of the O.H.B.D.C. Manual, assuming unyielding conditions. The following properties of granular backfill may be used for computations:

Granular 'A' $\gamma = 22.8 \text{ kN/m}^3$, $\phi' = 35^\circ$, $K_o = 0.426$

Granular 'B' $\gamma = 21.2 \text{ kN/m}^3$, $\phi' = 30^\circ$, $K_o = 0.5$

Dewatering

Concrete should be placed in the 'dry'. However, this should not be a problem since all boreholes were dry at the time of the investigation, therefore, all footing excavations should be above the groundwater level. The deposits over the bedrock are however water-bearing.

Frost Protection

For the footings placed on bedrock, no frost protection is required. Pile caps should have a minimum of 1.7m of earth cover for frost protection.

Lateral Forces

For the purposes of computing resistance to lateral forces the coefficient of friction between the underside of concrete footings and the bedrock may be assumed to be $\tan 30^\circ$ and the footing should be keyed into the bedrock 0.5 m.

Approach Embankments

Topsoil and surficial material should be removed prior to placing any fill. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches at locations through which piles have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than 75mm.

The proposed widening should have side slopes not steeper than two horizontal to one vertical designed and constructed in accordance with the appropriate Ministry standards.

Settlement

No settlements are to be expected since the footings are to be placed on bedrock.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. J. Matthews, Co-Op Student, under the supervision of Mrs. P. Marks, Project Foundations Engineer. The equipment used for the foundation investigation was owned and operated by F. E. Johnston Drilling Co. Ltd. This report was prepared by Mrs. Pamela Marks and reviewed by Mr. Ken Selby.



P. Marks, P. Eng.

Project Foundations Engineer

K. G. Selby, P. Eng.

Chief Foundations Engineer

(West)

APPENDIX

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

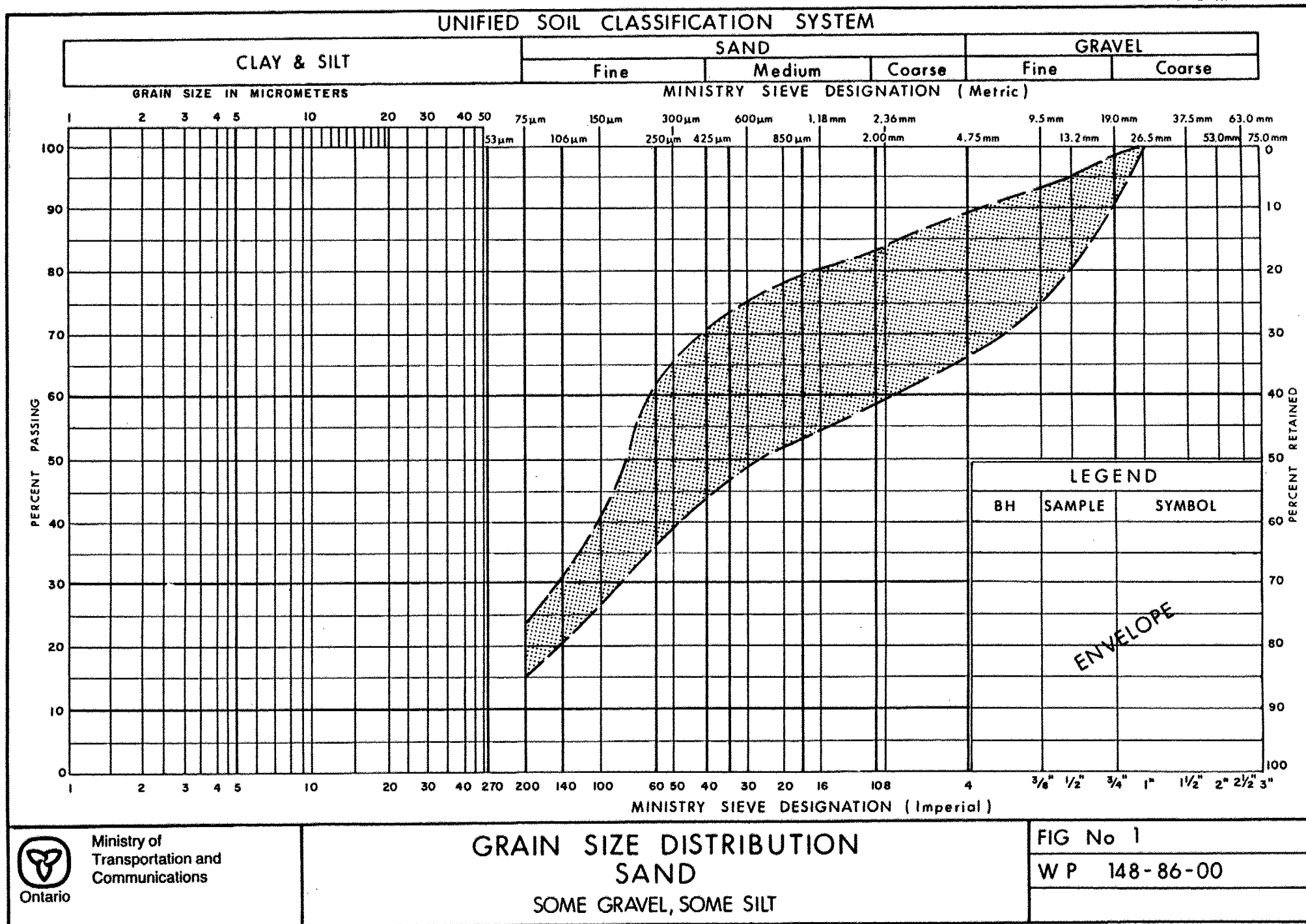
u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						



DESCRIPTION OF ROCK CORE - WP 148-86-00

CORE RECOVERY				CORE DESCRIPTION	
HOLE #	DEPTH (m)	%CR*	%RQD*	DEPTH (m)	DESCRIPTION
1	1.04- 2.41	30	0	1.04- 4.26	GNEISS, light grey to pink; banded, foliated, medium to coarse crystalline; medium strong to strong rock; unweathered to slightly weathered; extremely close to close spaced fractures.
	2.41- 3.94	30	0		
	3.94- 5.46	53	7	4.26- 6.98	GNEISS, dark grey to black; foliated, fine crystalline; medium strong to strong rock; unweathered to slightly weathered; very close to moderately close spaced fractures.
	5.46- 6.98	100	65		
2	1.19- 2.72	72	16	1.19- 3.53	GNEISS, medium to light grey; foliated, fine crystalline; medium strong to strong rock; unweathered to slightly weathered; very close to close spaced fractures.
3	1.22- 3.12	51	53	1.22- 3.12	GNEISS, medium grey to dark grey; foliated, fine crystalline; medium strong to strong rock; unweathered to slightly weathered; very close to close spaced fractures.
4	4.14- 5.69	59	46	4.14- 7.26	GNEISS, medium grey, streaked pink; foliated, medium to fine crystalline; medium strong to strong rock; unweathered to slightly weathered; close to moderately close spaced fractures.
	5.69- 7.26	100	95		

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

RECORD OF BOREHOLE No 1

METRIC

W P 148-86-00 LOCATION Sta. 10 +034.0 m; O/S 9.8 m Lt C Hwy. 60 ORIGINATED BY JM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY DM
DATUM Geodetic DATE 87 08 17 to 87 08 18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
303.5	Ground Level												
0.0	Silty Clay												
302.5	Trace of Sand		1	SS	60%	13 cm							
1.0	Firm to Stiff		2	RC	Rec 30%								
	Sound		3	RC	Rec 30%								
	Gneiss		4	RC	Rec 53%								
	Bedrock		5	RC	Rec 100%								
296.5													
7.0	End of Borehole												
	* Groundwater Level not observed												

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 2

METRIC

W P 148-86-00 LOCATION Sta. 10 + 000.2; O/S 10.2 m Lt & Hwy.60 ORIGINATED BY JM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (H.S.) COMPILED BY DM
DATUM Geodetic DATE 87 08 18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
303.2	Ground Level													
0.0	Sand, Some Gravel Some Silt					*								
302.0	Dense to Very Dense		1	SS	49	18 cm	302							21 62 (17)
1.2	Sound Gneiss		2	RC	Rec 72%									
299.7	Bedrock		3	RC	Rec 65%		300							
3.5	End of Borehole													
	* Groundwater Level Not Observed													

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 148-86-00 LOCATION Sta: 9 + 999.6; O/S 9.7 m Rt. E Hwy. 60 ORIGINATED BY JM
DIST 11 HWY 11 BOREHOLE TYPE BX Casing COMPILED BY DM
DATUM Geodetic DATE 87 08 18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p	W	W _L	WATER CONTENT (%)					
303.1	Ground Level					*											
0.0	Boulders																
301.9	Sound Gneiss																
1.2	Bedrock		1	RC	REC 51%												
300.0	End of Borehole																
3.1	* Groundwater Level Not Observed																

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 148-86-00 LOCATION Sta: 10 + 032.5; O/S 11.1 m Rt. E Hwy. 60

ORIGINATED BY JM

DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS)/BX Casing

COMPILED BY DM

DATUM Geodetic DATE 87 08 19

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
303.6	Ground Level												
0.0													
	Sand		1	SS	61	20 cm							
	Some Gravel		2	SS	307	3 cm							
	Some Silt		3	SS	602	15 cm							
	Very Dense		4	SS	637	15 cm							
299.5			5	SS	662	10 cm							
4.1	Weathered												
	Sound		6	RC	REC 46%								
	Gneiss												
	Bedrock		7	RC	REC 95%								
296.3													
7.3	End of Borehole												
	* Groundwater Level Not Observed												

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 5

METRIC

W P 148-86-00 LOCATION Sta: 9 + 954.8 m; O/S 9.8 m Rt. E Ramp 'B' ORIGINATED BY JM
DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (S.S.) COMPILED BY DM
DATUM Geodetic DATE 87 08 19 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%)						
309.9	Ground Level																
0.0	Sand, Some Gravel Some Silt		1	AS		*											
308.1	Presumed Dense																
1.8	End of Borehole Presumed Sound Gneiss Bedrock						308										
	* Groundwater Level Not Observed																

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 6

METRIC

W P 148-86-00 LOCATION Sta: 9 + 956.2 O/S 9.7 m Rt. C Ramp 'B' ORIGINATED BY JM
DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (S.S.) COMPILED BY DM
DATUM Geodetic DATE 87 08 19 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
309.9	Ground Level																
0.0	Sand Some Gravel, Some		1	AS													GR SA SI CL
309.3	Silt - Presumed Dense																20 57 (23)
0.6	End of Borehole																
	Presumed Sound Gneiss Bedrock					*	308										
	* Groundwater Level Not Observed																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 7

METRIC

W P 148-86-00 LOCATION Sta: 9 + 956.7, O/S 5.0 m Rt. E Ramp 'B' ORIGINATED BY JM
DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (S.S.) COMPILED BY DM
DATUM Geodetic DATE 87 08 19 CHECKED BY [Signature]

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8

METRIC

W P 148-86-00 LOCATION Sta: 9 + 956.3, O/S 0.7 m Lt. C Ramp 'B' ORIGINATED BY JM
 DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (S.S.) COMPILED BY DM
 DATUM Geodetic DATE 87 08 09 CHECKED BY LD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
309.4	Ground Level													
0.0	Sand, Some Gravel, Silt		1	AS										
308.9	Presumed Dense													
0.5	End of Borehole					*								
	Presumed Sound Gneiss Bedrock						308							
	* Groundwater Level Not Observed													

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

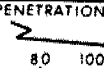



20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 9

METRIC

W P 148-86-00 LOCATION Sta: 9 + 955.9, O/S 4.7 m Lt. E Ramp 'B' ORIGINATED BY JM
 DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (S.S.) COMPILED BY DM
 DATUM Geodetic DATE 87 08 19 CHECKED BY LM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
308.9	Ground Level															
0.0	Sand, Some Gravel Some Silt Presumed Dense		1	AS											12 66 (22)	
307.5	End of Borehole															
1.4	Presumed Sound Gneiss Bedrock * Groundwater Level Not Observed															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 10

METRIC

W P 148-86-00 LOCATION Sta: 9 + 955.9, O/S 8.4 m Lt. E Ramp 'B' ORIGINATED BY JM
 DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (S.S.) COMPILED BY DM
 DATUM Geodetic DATE 87 08 19 CHECKED BY 12

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
308.3	Ground Level																
0.0	Sand, Some Gravel, Silt																
307.5	Presumed Dense																
0.8	End of Borehole																
	Presumed Sound Gneiss Bedrock					*											
	* Groundwater Level Not Observed																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

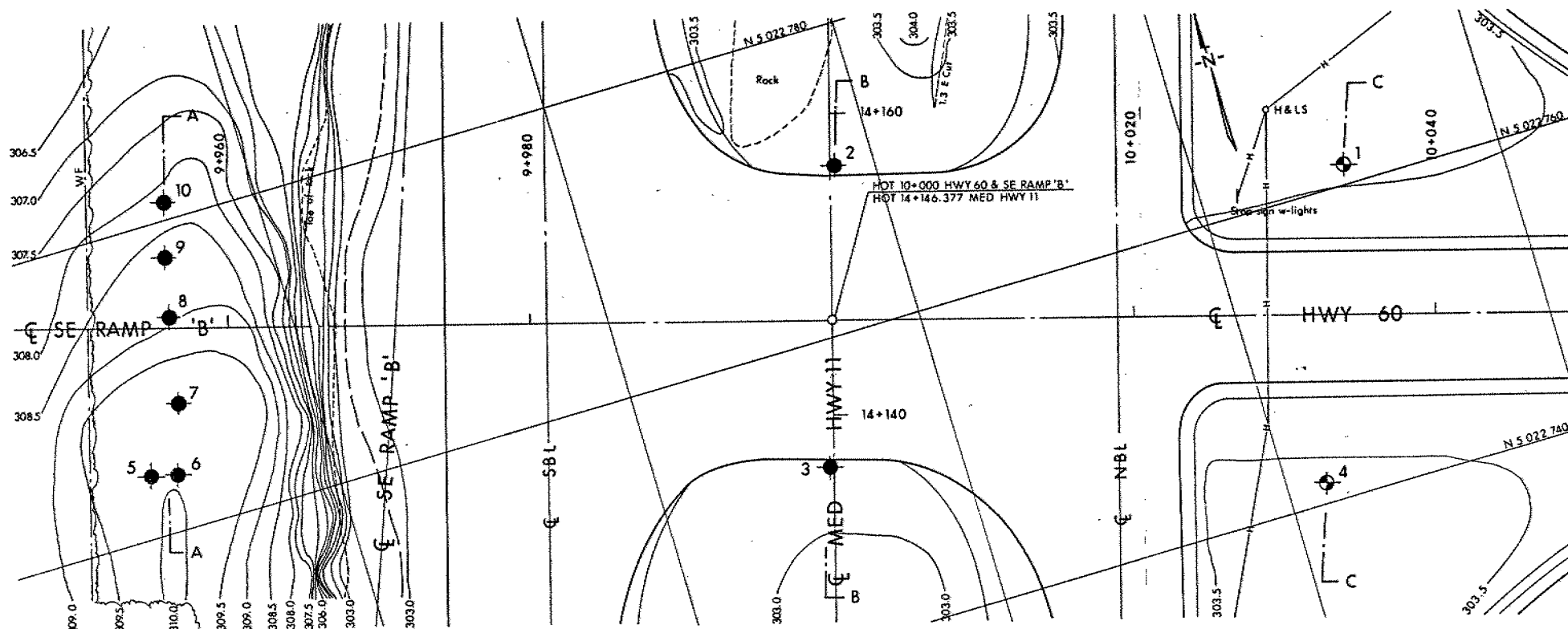
CONT No
WP No 148-86-00

HIGHWAY 60

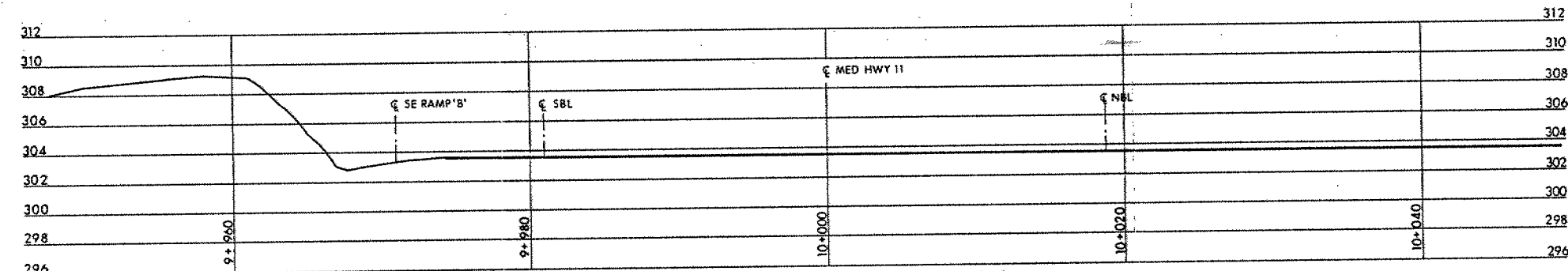
BORE HOLE LOCATIONS & SOIL STRATA



SHEET

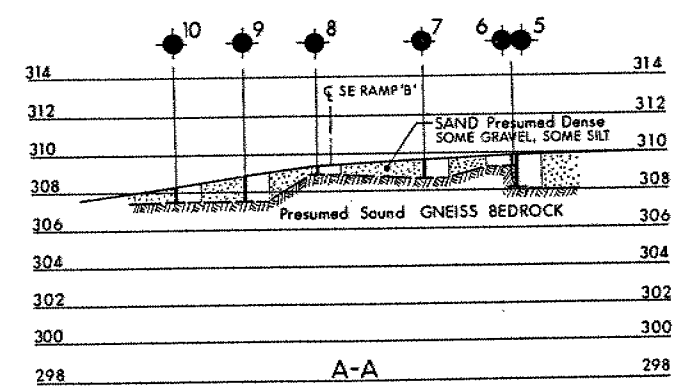


PLAN
SCALE
4m 2 0 4m

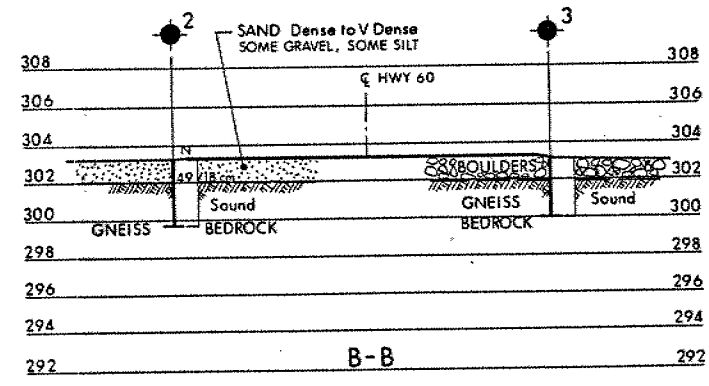


PROFILE HWY 60 & SE RAMP 'B'

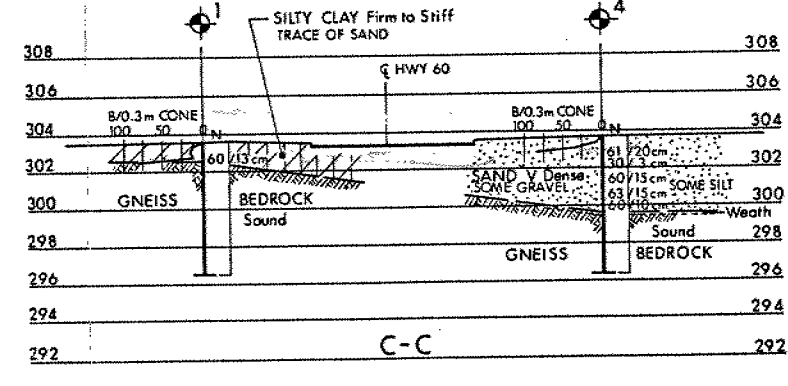
SCALE
4m 2 0 4m



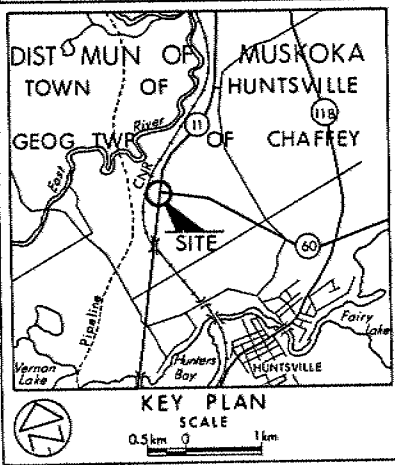
A-A



B-B



C-C



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation
- W L not observed in all bore holes

No	ELEVATION	STATION	OFFSET
1	303.5	10+034.0	9.8 m LT
2	303.2	10+000.2	10.2 m LT
3	303.1	9+999.6	9.7 m RT
4	303.6	10+032.5	11.1 m RT
5	309.9	9+954.8	9.8 m RT
6	309.9	9+956.2	9.7 m RT
7	309.7	9+956.7	5.0 m RT
8	309.4	9+956.3	0.7 m LT
9	308.9	9+955.9	4.7 m LT
10	308.3	9+955.9	8.4 m LT

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION
1			

HWY No 11	DIST 11
SUBMD PM CHECKED DATE 1987 11 09	SITE 42-190
DRAWN SO CHECKED APPROVED	DWG 1488600-A

MEMORANDUM

①

M. DEUTA
CHIEF FOUNDATION ENG.
RM 315, CENTRAL BLDG.

DATE: 91 01 29

FROM: P. PAYER
FOUNDATION DESIGN

RE: PROJECT CONSTRUCTION REPORT
CONT. NO. 89-17
HWY. #11 & #60
DISTRICT #11 (HUNTSVILLE)

AS PER YOUR REQUEST I HAVE REVIEWED THE FOUNDATION RELATED PART OF THE ABOVE REPORT PREPARED BY G. TERRY FORB PROJECT SUPERVISOR AND APPROVED BY STAN. G. WILSON, CONSTRUCTION MANAGER OF NORTHERN REGION.

PARAGRAPHS #1, #2 AND #3 OF THE 'GEOTECHNICAL INFORMATION' (SEE ATTACHMENT 'A') ARE DEALING WITH FOUNDATION RELATED PROBLEMS FOR BOTH ABUTMENTS AND FOR THE CENTER PIER. THE ACTUAL BEDDED LINE, THE CONSTRUCTION REPORT CLAIMS, FOR ALL THREE FOOTINGS WERE LOWER THAN INDICATED ON THE FOUNDATION DRAWING (DWG. #2) AND ON THE RECORD OF BOREHOLE SHEETS. THE RESULT OF THE LOWER BEDROCK LINE REQUIRED ADDITIONAL OVERBURDEN EXCAVATION ADDITIONAL QUANTITIES OF GRANULAR 'A' AND CONCRETE AND ALSO THE COMPLETE RE-DESIGNMENT OF THE WEST ABUTMENT FOR GRAND TOTAL OF

\$119,551.

FOLLOWING MY REVIEW OF THE SAID 'CONSTRUCTION REPORT, I HAVE STUDIED THE AVAILABLE INFORMATION CONTAINED IN THE FOUNDATION INVESTIGATION AND DESIGN REPORT (PREPARED IN-HOUSE) AND ALSO IN THE FOUNDATION FILE. MY COMMENTS ARE LISTED BELOW.

- a.) THE FOUNDATION REQUEST DID NOT INDICATE THE FINAL FOOTING LOCATIONS AND DID NOT CONTAIN E-PLAN (SEE ATTACHMENT 'B').
- b.) THE SITE WAS NOT STAKED FOR FIELD INVESTIGATION (SEE ATTACHMENT 'C').
- c.) AT THE WEST ABUTMENT, SIX BOREHOLES WERE DRILLED (UP TO 1.8m DEEP) BUT NOT ONE SINGLE BOREHOLE PENETRATED THE BEDROCK, THEREFORE THE QUALITY OF THE ROCK COULD NOT BE ASSESSED.
- d.) DURING THE OVERBURDEN ^{EXCAVATION} FOR THE WEST ABUTMENT IT HAS BECOME EVIDENT THAT THE BEDROCK IS SHATTERED TO A GREAT EXTENT. MY SITE VISIT (1989 10 11) CONFIRMED THE SITUATION AND NEW RECOMMENDATIONS WERE PROVIDED TO THE AREA CONSTRUCTION ENGINEER (T. FLETCHER) BY THE UNDERSIGNED (SEE ATTACHMENT 'D').
- e.) AT THE EAST ABUTMENT THE BOREHOLES (#1 AND #4) WERE LOCATED SOME 6-7m WEST OF THE FOOTING LOCATION, WHICH MAY EXPLAINS THE DISCREPANCY OF THE BEDROCK SURFACE ELEVATION.
- f.) THE LOWER BEDROCK LEVEL AT THE CENTER PIER MAY BE RESULT OF THE OVEREXCAVATION BY THE CONTRACTOR. HOWEVER, I CAN NOT PROVE THIS FACTOR.
- g.) IT IS MY OPINION, THAT SOME ^{PORTION} OF ^{THE} ADDITIONAL CONSTRUCTION COST MAY HAVE BEEN INCLUDED

IN THE ORIGINAL BID, PROVIDED THE CORRECT
BEDROCK ELEVATIONS WERE GIVEN IN OUR
REPORT.

b.) THE NAMES OF THE FOUNDATION DESIGN
SECTION PERSONNEL INVOLVED IN THE PRE-
ENGINEERING STAGE OF THIS PROJECT ARE
LISTED IN OUR REPORT.

c.) ONE FINAL COMMENT: PLEASE DO NOT
START FIELD INVESTIGATION WITHOUT PROPER
FOOTING LOCATION AND SUPERVISION.

P. PAYER, P. ENG.
SENIOR FOUNDATION ENGINEER

memorandum



Tel.: 235-3731

To: D. Sproule
Structural Project Engineer
Northern Region

Date: 1988 03 03

From: Foundation Design Section
Room 315, Central Building

RE: Highway 11 & 60 Interchange Underpass
W.P. 148-86-02, Site 42-190
District 11

General Arrangement Drawing 42-190-P1 was reviewed and we have the following comments:

- 1) Existing pavement should be removed at locations where piles are to be driven.
- 2) The East Abutment Pile Cap requires 1.7 m of earth cover for frost protection. Measurements scaled from the drawing indicate only ~~1.0 m~~ of frost protection is being provided.

2.0 m
SMH

A handwritten signature in dark ink, appearing to read "S. Holmes".

S. Holmes
Foundation Engineer

SH/mj

memorandum



Tel: 3731

To: K. Bassi
Head, Design Section
Structural Office
3501 Dufferin Street

Date: 1988 01 28

Atten: D. Sproule

From: Foundation Design Section
Room 315, Central Building

RE: W.P. 148-86-00, Site 42-190
Highway 11/60, Interchange, Underpass
District #11, Huntsville

The following is in reply to our discussion on 88 01 26 with D. Sproule regarding an additional alternative for supporting the east abutment on a spread footing placed on a granular pad. The following additional recommendations are being made with regards to this alternative.

The east abutment may be supported on spread footings placed on well compacted Granular 'A'. A detailed construction scheme is outlined in Figure 1 attached. A safe design load of 340 kPa may be used for design purposes. For the purposes of the O.H.B.D.C. the following values are recommended:

Factored Bearing Capacity at U.L.S.: 900 kPa


Bearing Capacity at S.L.S. Type II: 340 kPa

In order to compute resistance to sliding between the footing and the granular material, it is recommended that a coefficient of friction of $\tan 35^\circ$ be assumed. Other properties of the granular backfill, frost protection etc. were given in the Foundation Investigation Report.

Differential settlement between the west abutment supported on bedrock and the east on granular are considered to be negligible, and should not exceed 25 mm.

In reference to your question regarding minimum pile length, conventionally the minimum used is 3 m. However, there appears to be no technical reason for a minimum embedded length other than frost considerations and the practical problems incurred in installing short piles.

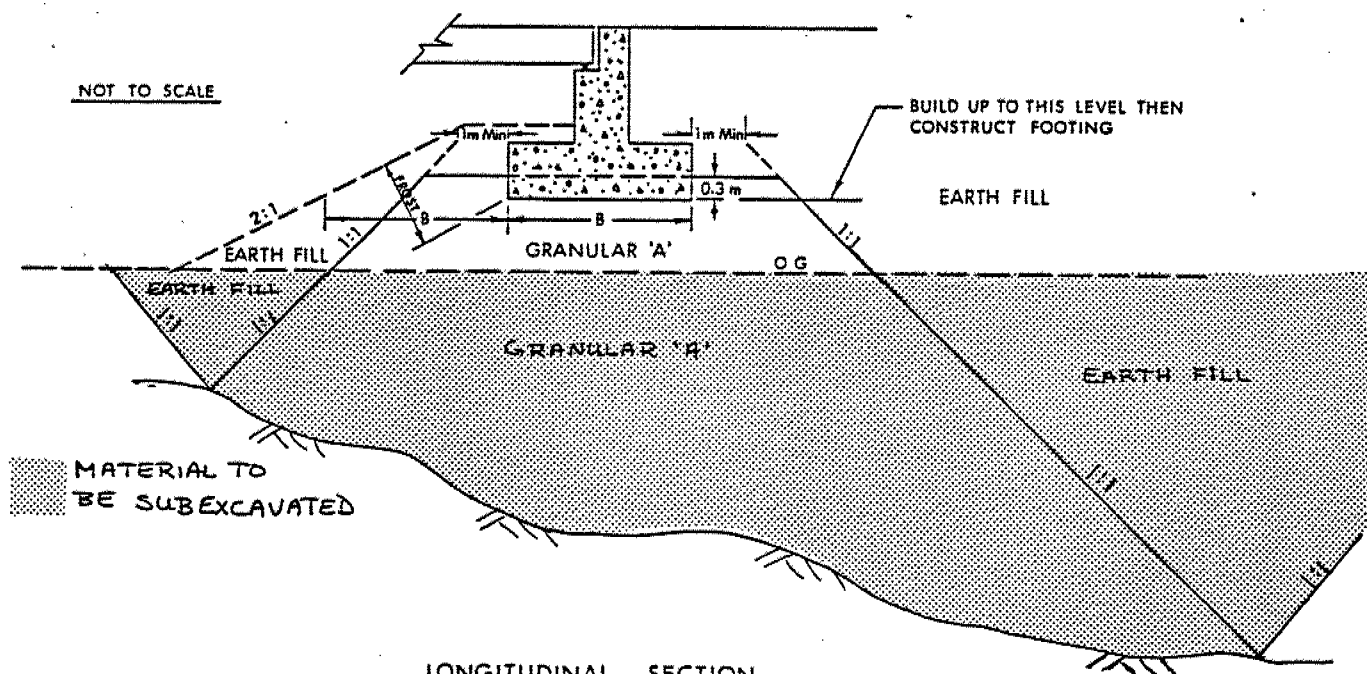
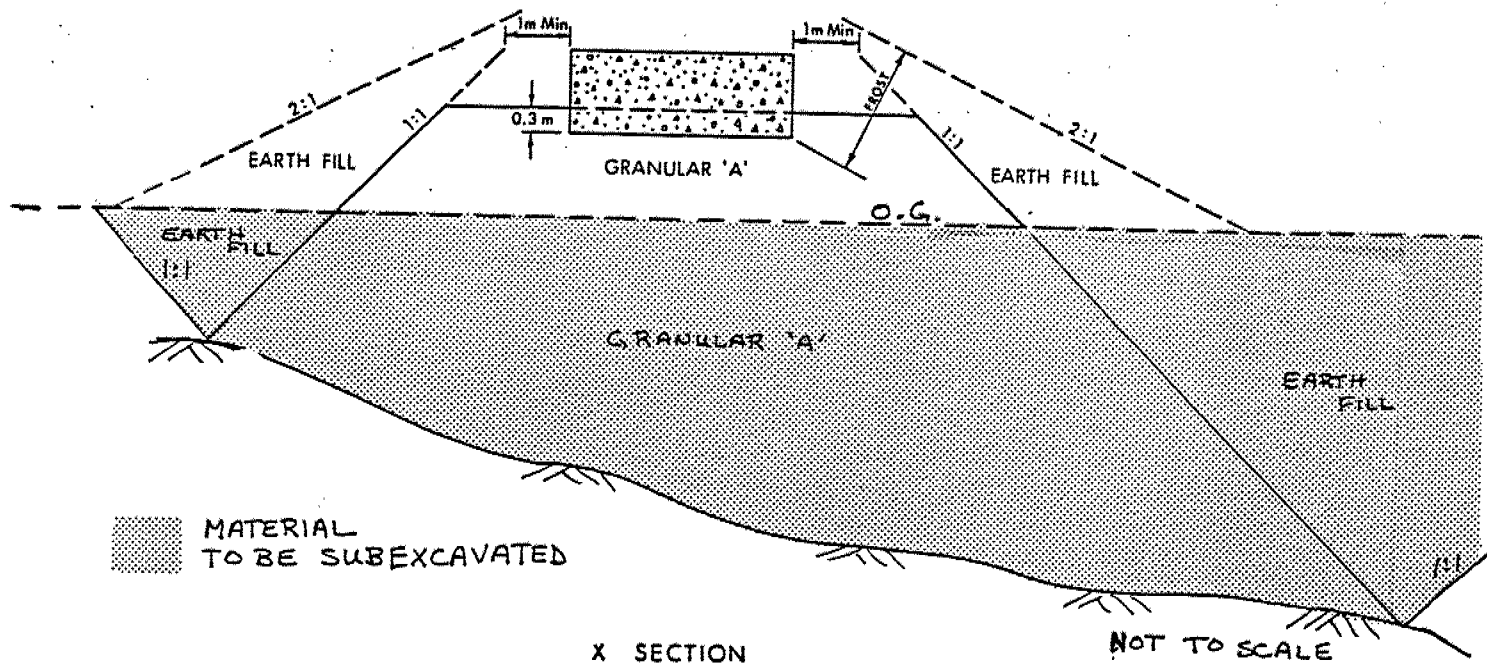
Should you require any further information, please do not hesitate to contact this office.


P. Marks, P. Eng.
Foundation Engineer

PM/mmj

c.c. - C. Verhulst

Attach.



NOTES:

- 1- REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2- PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T C STANDARDS.
- 3- CONSTRUCT CONCRETE FOOTING.
- 4- PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.

memorandum



Tel: 3731

To: T. Fletcher
Area Construction Engineer
Northern Region

Date: 1989 10 13

Atten: T. Ford

From: Foundation Design Section
Room 315, Central Building

RE: Structure Construction
West Abutment
Hwy. #11 and Hwy. #60
Contract 89-17
District #11 (Huntsville)

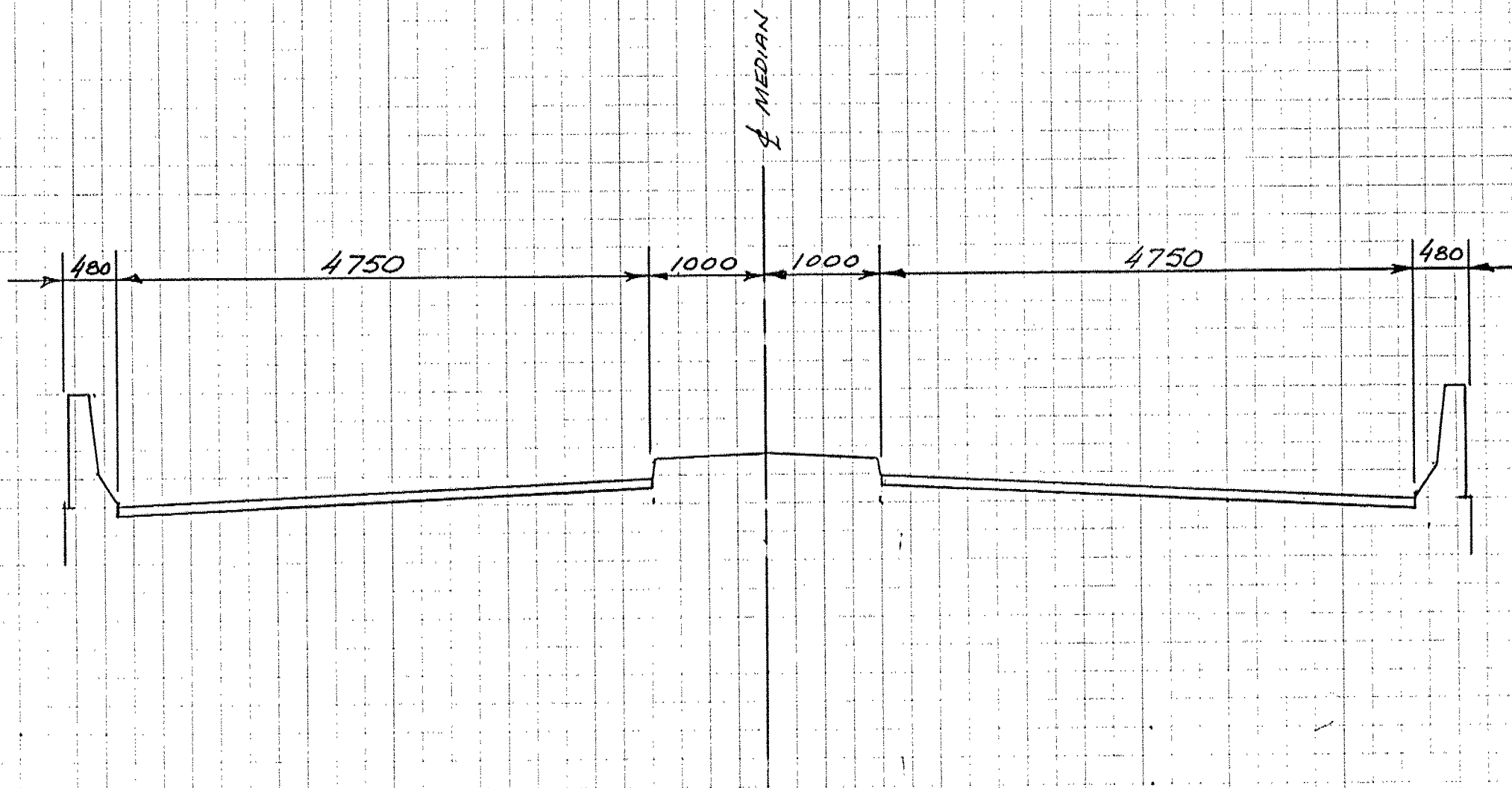
The following recommendations were given to you at the site on 89 10 11 by the undersigned:

1. Remove rock to El. 306
2. Should the bedrock be fractured at this level, extend the removal for 1 m more and bring it up with mass concrete.
3. The footing should be redesigned using factored bearing capacity at U.L.S. of 7500 kPa.

PP/mmj

c.c. - P. Furst
B. Farago


P. Payer, P. Eng.
Sr. Foundation Engineer



DECK X-SECTION

Hwy. 11 & 60

INTERCHANGE UNDERPASS